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EXAMINER

SONG, MATTHEW J

ART UNIT	PAPER NUMBER
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1765

DATE MAILED: 01/15/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

AS

Office Action Summary

Application No.

10/047,323

Applicant(s)

LAMPERT ET AL.

Examiner

Matthew J Song

Art Unit

1765

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 20 October 2003.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1 and 6 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1 and 6 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. §§ 119 and 120

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
* See the attached detailed Office action for a list of the certified copies not received.
- 13) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application) since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.
a) ☐ The translation of the foreign language provisional application has been received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121 since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892) 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948) 5) ☐ Notice of Informal Patent Application (PTO-152)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ 6) ☐ Other: _____

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 10/20/2003 has been entered.

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

Art Unit: 1765

3. Claim 1 is rejected under 35 U.S.C. 103(a) as being unpatentable over Powell (US 5,248,385) in view of Fissel et al (Low temperature growth of SiC thin films on Si and 6H-SiC by solid source molecular beam epitaxy) along with Tashiro (JP 62-091492), an English Abstract has been provided, Hamza et al (US 5,861,346), Pickar (US 3,385,723) and Furukawa et al (US 5,288,365).

Powell discloses a method of growing homoepitaxial films of 6H-SiC on low-tilt-angle vicinal (0001) SiC wafers (Abstract and col 4, ln 15-25). Powell discloses a first step of cutting and polishing a SiC wafer such that the polished surface of the wafer is slightly misoriented from the SiC basal plane, a second step of a pregrowth etch to remove all contamination, defects or surface disturbances, and the pregrowth etch is to cause homoepitaxial growth rather than heteroepitaxial growth (col 3, ln 5-68). Powell also discloses the wafer is polished on one face with diamond paste using conventional polishing techniques, this reads on applicant's chemical-mechanical polishing (col 5, ln 1-21). Powell also discloses the growing of the SiC film by any suitable means, including conventional processes such as molecular beam epitaxy (col 4, ln 1-10 and col 6, ln 30-35).

Powell discloses a method of growing a homoepitaxial SiC film and is not particular to the method used to grow the SiC film. Powell does not teach using a solid source method of growing SiC in a MBE system.

Fissel et al discloses a method of SiC growth on 6H-SiC by solid source molecular beam epitaxy (MBE). Fissel et al also discloses source materials of high purity polycrystalline silicon, this reads on applicant's solid Si, and of high purity of pyrolytic carbon were coevaporated separately, by means of electron beam guns (pg 3182, col 1). Fissel et also discloses SiC

Art Unit: 1765

substrates prepared from Acheson grown crystals, this reads on providing a substrate, were scrubbed with liquid detergent, HF-dipped, cleaned in hot HCl and heated to 600°C for 30 min in a separated preparation chamber, this reads on preparing said substrate, before loading into the deposition chamber (pg 3182, col 2). Fissel et al also discloses the chamber pressure was held at 5×10^{-7} - 8×10^{-8} Pa, this reads on evacuating the growth chamber.

Powell teaches CVD, MBE or other conventional method of growing SiC can be used to grow a homoepitaxial SiC film. Therefore, it would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Powell with Fissel et al's solid source MBE method of growing SiC because substitution of known equivalents for the same purpose is held to be obvious (MPEP 2144.06).

The combination of Powell and Fissel et al does not teach an MBE system having effusion cells having shutters and charging crucibles with materials, installing the crucibles into effusion cells a placing the effusion cells into the growth chamber.

In a molecular beam epitaxy device, Tashiro teaches a cell shutter is in front of the surface of plural cells each having a crucible charged with a raw material and growing a crystal. Tashiro also teaches a crucible 1 charged with a raw material 2 in a cell 8 and opening and closing the shutters 3 to form an epitaxial crystal (Abstract). It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Powell and Fissel et al with Tashiro MBE device with shutters to control the flux of raw materials in an effusion cell.

In a method of forming SiC films, note entire reference, Hamza et al teaches growing crystalline thin films of silicon carbide on silicon substrate via reaction of silicon with C₆₀, this

Art Unit: 1765

reads on applicant's fullerenes (col 2, ln 20-45). Hamza et al also teaches a molecular beam scattering apparatus consists of three vacuum chambers and a source chamber houses a C_{60} Knudsen source and a mechanical chopper, this reads on applicant's shutter (col 3, ln 1-45). Hamza et al also teaches the C_{60} may be in solid form and to achieve thicker films silicon may be vaporized along with C_{60} to deposit SiC on a silicon substrate (col 3, ln 45-67). It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Powell, Fissel et al and Tashiro with Hamza et al's C_{60} source of carbon because SiC can be formed at low temperatures in a hydrogen-free environment (col 1, ln 15-65).

The combination of Powell, Fissel et al, Tashiro and Hamza et al does not teach coating a crucible with a layer of SiC.

In a method of reducing impurities in a Silicon melt, Pickar teaches a method of producing carbon articles having a protective coating against highly reactive gases or liquids at high temperatures. Pickar also teaches a pure graphitic crucible having a coating of polycrystalline beta silicon carbide in which molten silicon or other highly reactive liquids can be maintained for many hours at high temperatures without causing introduction of impurities into the melt (col 1, ln 20-72). Pickar also teaches in order to obtain a layer of the silicon carbide of the desired thickness it is advisable to repeat the steps of forming a silicon carbide and can be used over and over again or recoated with silicon carbide for further use (col 3, ln 1-30), this reads on applicant's coating, exposing and repeating the coating step. It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Powell, Fissel et al, Tashiro and Hamza et al with Pickar because a SiC coated

Art Unit: 1765

graphite crucible does not react with or cause contamination of a melt, thereby producing crystal of extreme purity ('723 col 1, ln 35-40).

The combination of Powell, Fissel et al, Tashiro, Hamza et al and Pickar does not teach the temperature claimed of the first and second effusion cells. It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Powell, Fissel et al, Tashiro, Hamza et al and Pickar by optimizing the temperature by conducting routine experimentation of result effective variable. Also, the selection of reaction parameters such as temperature and concentration is obvious (In re Aller 105 USPQ 233, 255 (CCPA 1955)). Furthermore, Fullerenes are known to sublime at 550°C, note Gruen et al (US 5,620,512) and Silicon is known to sublime at 1600°C, note Shiomi et al (US 6,193,797).

The combination of Powell, Fissel et al, Tashiro, Hamza et al and Pickar does not teach the substrate temperature is 1500°C.

In a method of growing SiC by MBE (col 3, ln 15-67), Furukawa et al teaches the temperature of a seed crystal is preferably 1100°C-2400°C to regulate the crystal structures of the silicon carbide single crystals and by controlling temperature of the seed crystal, a number of crystal structures of silicon carbide, such as 6H can be easily regulated (col 4, ln 10-67), this a teaching that substrate temperature is a result effective variable. Therefore, it would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Powell, Fissel et al, Tashiro, Hamza et al and Pickar by optimizing the substrate temperature to obtain a desired crystal structure by conducting routine experimentation of a result effective variable (MPEP 2144.05). Furthermore, where the general conditions of a claim are disclosed in the prior

Art Unit: 1765

art, it is not inventive to discover the optimum or workable ranges by routine experimentation.

(In re Aller, 220 F.2d 454, 456, 105 USPQ 233, 235(CCPA 1955)).

4. Claim 1 is rejected under 35 U.S.C. 103(a) as being unpatentable over Powell (US 5,248,385) in view of Fissel et al (Low temperature growth of SiC thin films on Si and 6H-SiC by solid source molecular beam epitaxy) along with Tashiro (JP 62-091492), an English Abstract has been provided, Hamza et al (US 5,861,346), Pickar (US 3,385,723) and Furukawa et al (US 5,288,365), as applied to claim 1 above, and further in view of Powell et al (US 5,915,194) or Burd (US 3,675,619).

The combination of Powell, Fissel et al, Tashiro, Hamza et al, Furukawa et al and Pickar teaches all of the limitations of claim 5, including polishing a wafer with a diamond paste using conventional polishing techniques, which the Examiner has interpreted to reads on applicant's chemical mechanical polishing. Should it be demonstrated that it does not reads on applicant's chemical mechanical polishing; the feature would be obvious in view of Powell et al or Burd.

In a method of preparing SiC substrates for epitaxial growth of SiC, Powell et al teaches a SiC substrate **24** is pretreated to remove contaminants or impurities on the surface to facilitate the growing of high-quality, low defect epitaxial films, where various pregrowth treatments such as oxidation, chemical mechanical polishing or reactive ion etching may be used to remove potential unwanted nucleation sites prior to growth the crystal epilayers (col 11, ln 45-65). It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Powell, Fissel et al, Tashiro, Hamza et al, Furukawa et al and Pickar

Art Unit: 1765

with Powell et al to remove impurities on the surface of the substrate to facilitate the growing of high-quality, low defect epitaxial layers.

In a method of producing epitaxial films, Burd teaches substrates are prepared by an abrasive polishing, this reads on applicant's chemical mechanical polishing, a chemical polishing, rinsed with pure water and dried with a stream of pure nitrogen, this reads on applicant's pressurized N₂ (col 10, ln 50 to col 11, ln 5). Burd also teaches a variety of substrates including the same materials used in epitaxial films, compounds of elements of Group II and VI and compounds of Group I and VII and elements of Si and Ge (col 7, ln 1-35). It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Powell, Fissel et al, Tashiro, Hamza et al, Furukawa et al and Pickar with Burd's substrate preparation method to reduce surface contaminants and impurities.

5. Claim 6 is rejected under 35 U.S.C. 103(a) as being unpatentable over Powell (US 5,248,385) in view of Fissel et al (Low temperature growth of SiC thin films on Si and 6H-SiC by solid source molecular beam epitaxy) along with Tashiro (JP 62-091492), an English Abstract has been provided, Hamza et al (US 5,861,346), Pickar (US 3,385,723) and Furukawa et al (US 5,288,365) further in view of Burd (US 3,675,619) as applied to claim 1 above, and further in view of Sneed et al (US 5,354,384).

The combination of Powell, Fissel et al, Tashiro, Hamza et al, Furukawa et al, Pickar and Burd teach all of the limitations of claim 6, as discussed previously, except cleaning with pressurized CO₂.

Art Unit: 1765

In a method of cleaning a substrate, note entire reference, Sneed et al teaches a jet spray of carbon dioxide, this reads on applicant's pressurized CO₂, is used to remove molecular and particular contaminants from a variety of surfaces including silicon wafers, telescope mirrors and thin film optical coatings (col 1, ln 50-60). Sneed et al also teaches the jet spray may be used to clean any surface or structure requiring high levels of cleanliness or precision cleaning (col 4, ln 15-45). It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Powell, Fissel et al, Tashiro, Hamza et al, Furukawa et al, Pickar and Burd with Sneed's jet spray of CO₂ to remove molecular and particular contaminants from the surface of a substrate.

Response to Arguments

6. Applicant's arguments with respect to claims 1 and 6 have been considered but are moot in view of the new ground(s) of rejection. Applicant's arguments regarding a homoepitaxial film are considered moot in view of the new grounds of rejection.

7. Applicant's arguments filed 10/20/2003 have been fully considered but they are not persuasive.

In response to applicant's argument that the examiner's conclusion of obviousness is based upon improper hindsight reasoning, it must be recognized that any judgment on obviousness is in a sense necessarily a reconstruction based upon hindsight reasoning. But so long as it takes into account only knowledge which was within the level of ordinary skill at the time the claimed invention was made, and does not include knowledge gleaned only from the

Art Unit: 1765

applicant's disclosure, such a reconstruction is proper. See *In re McLaughlin*, 443 F.2d 1392, 170 USPQ 209 (CCPA 1971).

In response to applicant's argument that there is no suggestion to combine the references, the examiner recognizes that obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion, or motivation to do so found either in the references themselves or in the knowledge generally available to one of ordinary skill in the art. See *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988) and *In re Jones*, 958 F.2d 347, 21 USPQ2d 1941 (Fed. Cir. 1992). In this case, Fissel et al is combined with Powell because Powell teaches other methods of SiC can be used, including MBE. Therefore, it would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Powell with Fissel et al's MBE process because substitution of known equivalents for the same purpose is held to be obvious (MPEP 2144.06). Tashiro et al is combined with Powell and Fissel et al because using a MBE apparatus with shutters improves control of the flux of raw materials, which is desirable.

Applicant's argument that Pickar does not teach coating a crucible with SiC is noted but is not found persuasive. Applicant alleges that Pickar teaches using sucrose and Si powder to form a coating, which is different from applicant's layer of SiC using SiC (pg 7). Pickar teaches forming a layer of silicon on graphite; therefore meets the limitation of coating a crucible with a layer of SiC.

In response to applicant's argument that the references fail to show certain features of applicant's invention, it is noted that the features upon which applicant relies (i.e., the chemistry and physics of forming the SiC layer (pg 7)) are not recited in the rejected claim(s). Although

Art Unit: 1765

the claims are interpreted in light of the specification, limitations from the specification are not read into the claims. See *In re Van Geuns*, 988 F.2d 1181, 26 USPQ2d 1057 (Fed. Cir. 1993).

In response to applicant's argument that the examiner's conclusion of obviousness is based upon improper hindsight reasoning (pg 7-8), it must be recognized that any judgment on obviousness is in a sense necessarily a reconstruction based upon hindsight reasoning. But so long as it takes into account only knowledge which was within the level of ordinary skill at the time the claimed invention was made, and does not include knowledge gleaned only from the applicant's disclosure, such a reconstruction is proper. See *In re McLaughlin*, 443 F.2d 1392, 170 USPQ 209 (CCPA 1971).

In response to applicant's argument that there is no suggestion to combine the references, the examiner recognizes that obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion, or motivation to do so found either in the references themselves or in the knowledge generally available to one of ordinary skill in the art. See *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988) and *In re Jones*, 958 F.2d 347, 21 USPQ2d 1941 (Fed. Cir. 1992). In this case, Burd teaches a method of substrate preparation to reduce surface contamination and impurities, which is desirable.

Conclusion

8. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Art Unit: 1765

Kaneda et al (MBE Growth of 3C SiC/ 6H SiC and the Electric Properties of Its p-n Junction) teaches the important parameters of MBE growth are the substrate temperature and molecular beam intensities. Kaneda et al also teaches a substrate temperature of 1100-1600°C (pg 537, Fig 5f and Fig 6c).

9. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Matthew J Song whose telephone number is 571-272-1468. The examiner can normally be reached on M-F 9:00-5:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nadine Norton can be reached on 571-272-1465. The fax phone number for the organization where this application or proceeding is assigned is (703) 872-9306.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0661.

Matthew J Song
Examiner
Art Unit 1765

MJS

SUPERVISORY
NADINE NORTON
PRIMARY EXAMINER
Nadine